Tower of Hanoi

Preface

Last week I had completed the intermediate exam for the second chapter of the Elements of AI course. I had the idea to implement the Tower of Hanoi [1] as an upcycling [2] project. This also reflects my current theoretical reflections on the topic of post-industrial design [3] and the role designers play in the context of our environmental awareness. I also like to bring things from theory into reality, because I can learn much faster and understand them better. Which doesn't mean I also like haptic communication.

In addition, I want to tackle small tasks in the future that are not necessarily in my area of interest at the moment. This also teaches me how to implement unusual concepts in design. If you only ever implement ideas that have something to do with Raspberry Pi [4] or Arduino [5], you will never get out of this pool to discover new ideas and maybe even mix them. Now the puzzle is not a new idea, but I had never seen anyone who had done it with gears before. I found this exciting and wanted to see if it could be implemented and what you can learn. When I was building the puzzle, I felt like I had hundreds of new ideas.

Materials

Most of the material is tools or I removed from old printers. There you really get a lot of gears in different sizes and also the metal rack I have from it. One should furnish oneself in the cellar or in the garage a corner with old materials. I have a cardboard for plastics, metals and pcbs. Small coasts for engines, gears, propellers and cables. You don't always have to throw it away immediately, because in most cases you can use it again and again for your own prototypes or projects. If you don't have an old printer, why don't you go to a scrap dealer? This one will certainly be able to help you and that shouldn't cost too much. But you can also buy all the new parts. That's up to your environmental conscience.

- Wood glue and brush
- Drill an drill inserts (wood)
- Safety goggles
- Sanding block
- Sanding paper
- Wood plate
- Wood saw
- Masking tape
- Primer spray
- Two spray color
- Gears (from a old printer)
- Nail polish remover
- Old rag
- Metal saw
- Metal rod (from a old printer)
- Metre stick

Realisation

Before we can do anything we have to clean the gears of oil and grind even small quirks. This saves us work later when we paint and regrind them. For the rehabilitation I personally took nail polish remover, but it would also have to be normal rinsing agent. It would just have to be fat-dissolving. Please note that rinse and nail polish remover are harmful to your body. Only clean the components in a well-ventilated room. If you have one, put on a respirator mask, which you can buy in the paint shop.
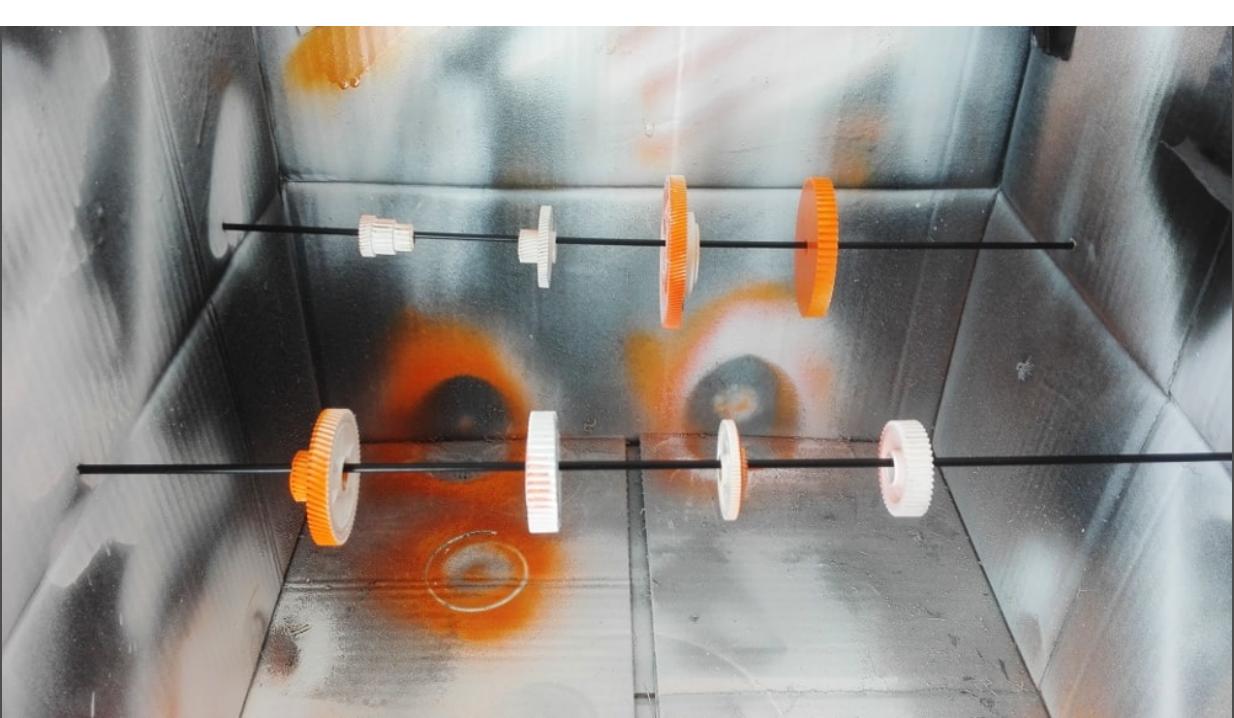
After cleaning, we can start painting the gears. From my previous projects I used a simple cardboard box for spraying. You can only work with it in the fresh air, but at the moment it has to be enough for me. At the first test I put the components on small pieces of wood. But that didn't work out so well, because they flew away again and again. So I took two thin plastic rods and put them through the walls of the box. This experiment worked a little better, but it's not a good solution either.

We first paint with the white primer. Then we grind off the coarse and unclean areas a little. Then spray two to three layers of the orange paint. Ideally, we let the paint dry for 24 hours, because fumes are still escaping from the paint. But you can still sand and repaint after half an hour if you are in a hurry.

The gears are already finished. Now we take care of the plate in which the rods are put in. To do this, we place the largest three gears side by side and measure them roughly with a metre rule. I have not worked to an accuracy of one millimetre now, because that is not always absolutely necessary. This project was about the fun of creating and assembling. Or maybe you have other sizes of gears, so I won't give any exact lengths here.

I first measured the length of the wooden plate and marked it with a ruler. But before I saw exactly, I punched the board into the parallel vice and roughly pre-sawn it. I don't have to work with a long board if I want to clamp it with the screw clamps. When everything is firmly clamped, you can saw much better and the edge becomes tidier, so that you no longer have to sand so much.

After we have sawn off everything cleanly, we measure the width with our metre rule and divide it by two. This is the middle. We draw a line along the entire length of the board. The three drill holes for the iron rods are then drilled on this. As you can see, my brain was offline and I had to cut something off at the end.
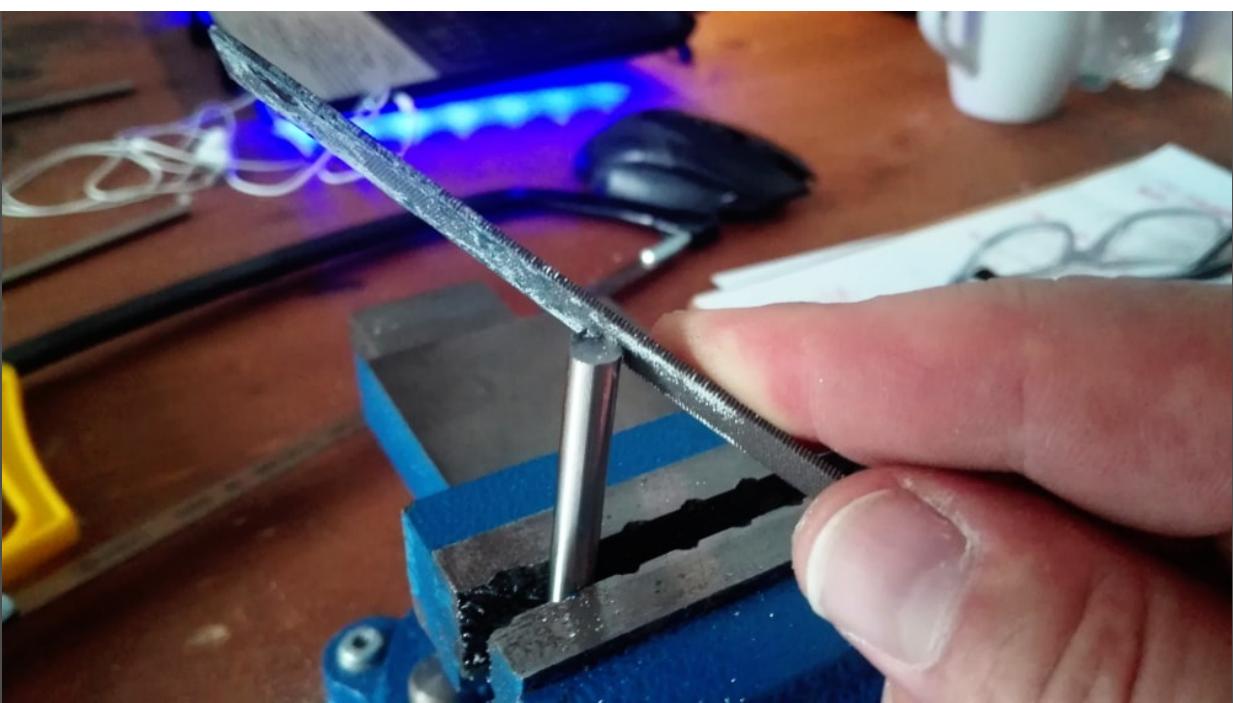
Now we saw the iron bar into three equally long pieces with our metal saw. So that we do not cut ourselves at the ends, we grind off the edges with a file. It's called deburring). We should always do this when working with metal, because most accidents can happen with sharp edges
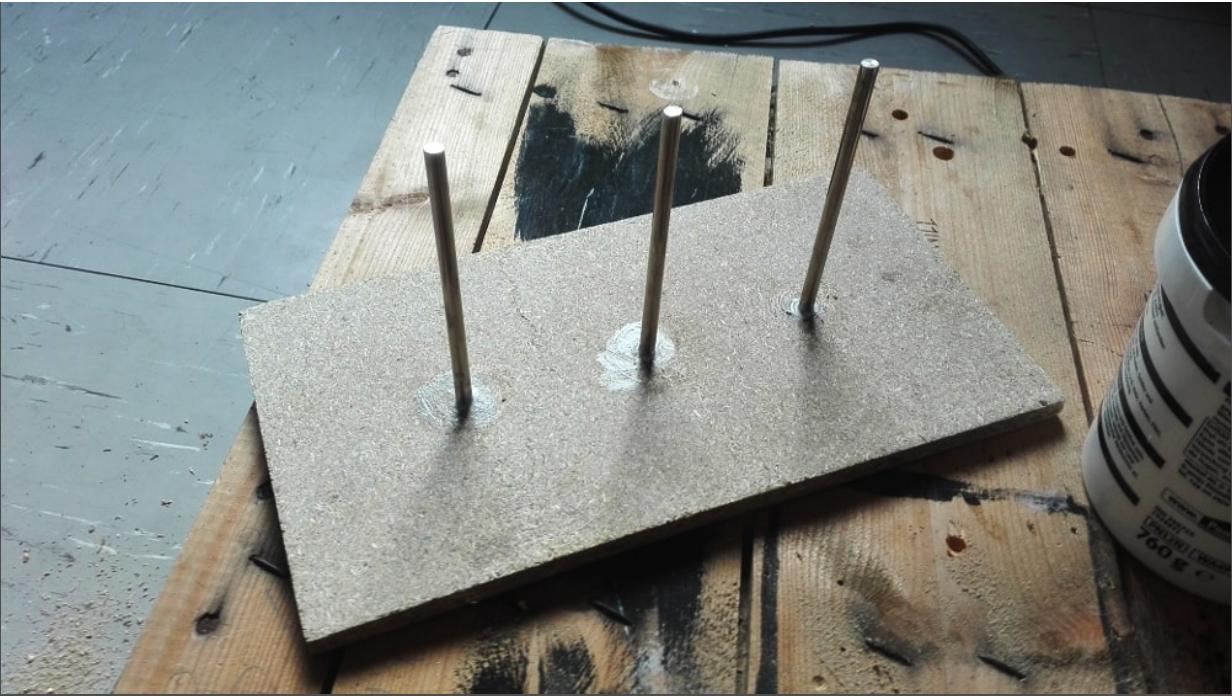
Now fix the three iron bars with wood glue in the wooden plate. To do this, insert one end of the bar into the glue, let it drip off a little and push it into the hole. We can fill small gaps in the bar with a toothpick. When we have enough time we let it dry again 24 hours. so the glue can dry out completely and everything should be as firm as possible. We push our gears onto the rods and see if everything fits.

Since some gears have a similar size, I marked them according to the Greek alphabet. I took a small touch-up pen (unfortunately I only had one in silver) and recorded the lower case letters one by one. If you are not sure if the order is correct, you can check it out. It's a little reminder. You can also use the normal alphabet or numbers, I'll leave that decision to you.

Now we only have to paint the wooden board. To do this we tape the poles with masking tape. As with the gears, we take the primer first and then the right color. I chose Thistle because it went well with the orange. Again, I don't want to interfere in your creativity. Of course you can use completely different colours or stick a paper collage on the wood or grind it with pens. I'm sure you'll think of something. After that we are done and have built our own Tower of Hanoi game. You can show it to your friends or family. Maybe they can solve the mystery right now, because you already know the solution, right?

Conclusion

Surprisingly, I had an incredible amount of fun with this project for children. I think it was because I didn't have to pay so much attention to measurements and rules this time. I didn't sand the wooden board perfectly either, just the way I wanted it. nothing more. Very exciting. As already mentioned above, I will implement a simple project in the next few months. Simply because I can do it and it gives me pleasure. But I have to put weights on the plate again, because this little hill is already very annoying.

Reference:

- [1] mathworld.wolfram.com/TowerofHanoi.html (fetched: Mi, Jan 23, 2019 11:13)
- [2] intercongreen.com/2010/02/17/recycling-vs-upcycling-what-is-the-difference/ (fetched: Mi, Jan

23, 2019 11:14)
- [3] designonline.org.au/post-industrial-design/ (fetched: Mi, Jan 23, 2019 11:16)
- [4] raspberrypi.org/ (fetched: Mi, Jan 23, 2019 11:17)
- [5] learn.sparkfun.com/tutorials/what-is-an-arduino/all (fetched: Mi, Jan 23, 2019 11:19)